

# Biosystematic Studies on the Genus *Polygonatum* (Asparagaceae)

## V. Taxonomic Revision of Species in Japan

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The taxonomy of *Polygonatum* in Japan is revised. Nine species, four nothospecies, including *P. × desoulavyi* (= *P. desoulavyi* var. *yezoense* = *P. miserum*), *P. × domonense* and *P. × azegamii* (= *P. desoulavyi* var. *azegamii*), and six varieties are recognized. *Desoulavy* 142 is superseded by *Desoulavy* 143 (both in LE) as a lectotype of *P. × desoulavyi*. It is presumed that *P. × desoulavyi*, *P. × domonense* and *P. × azegamii* are hybrid derivatives between *P. humile* and *P. involucratum*, between *P. involucratum* and *P. lasianthum*, and between *P. falcatum* and *P. involucratum*, respectively. *Polygonatum amabile* is considered to be a species distinct from *P. lasianthum*, as in Yatabe's original species concept. *Polygonatum trichosantherum* is reduced to var. *trichosantherum* under *P. falcatum*. A key to the species, nothospecies and varieties is provided.

Key words: Asparagaceae, Japan, Liliaceae, nothospecies, *Polygonatum*, *Polygonatum amabile*, *Polygonatum × azegamii*, *Polygonatum × desoulavyi*, *Polygonatum falcatum* var. *trichosantherum*, taxonomy

Thunberg (1784) first reported the species now identified as *Polygonatum* Mill. from Japan as *Convallaria polygonatum* L. (= *P. odoratum* (Mill.) Druce) and *C. multiflora* L. (*C. multiflora* auct. non L.: Thunb. = *P. falcatum* A. Gray). Since then, the number of taxa of *Polygonatum* reported from Japan has increased. Satake (1942) studied the bracteate species of *Polygonatum* and recognized four species in Japan, while Hara (1944) studied the ebracteate species and recognized six species, four varieties and three forms in Japan. The treatments of Satake (1942) and Hara (1944) are complementary and established the basis of the taxonomy of *Polygonatum* in Japan. Ohwi (1953) modified the treatments of Satake (1942) and Hara (1944), and recognized eleven species, five varieties and one form in Japan. Jeffrey (1980), however, combined a

number of them and recognized only seven species with no varieties and no forms. Satake (1982) recognized twelve species and six varieties in Japan. Satake's treatment was more or less in line with that of Ohwi (1953). Tamura (1990a, 1991, 1993) and Tamura *et al.* (1997) studied *Polygonatum* from the aspects of karyology, morphology of filaments and molecular phylogeny.

In the paper presented here, the taxonomy of *Polygonatum* in Japan is revised in light of recent studies (Tamura 1990a, 1991, 1993, Tamura *et al.* 1997), with the result that nine species, four nothospecies and six varieties are recognized in Japan.

## Materials and Methods

This taxonomic revision of *Polygonatum* in

Japan is based on a study of herbarium specimens preserved in E, EWH, HYO, K, KAG, KPM, KYO, MAK, OSA, SAPS, TI and TNS.

For chromosome examination of *Polygonatum*  $\times$  *desoulavyi* Kom. collected from Morita, Hayakita-cho, Yufutsu-gun, Iburi, Hokkaido, Japan (= *P. desoulavyi* var. *yezoense* (Miyabe & Tatew.) Satake), the root tip preparation was made by using the colchicine-aceto-orcin squash method of Tamura (1990a).

For pollen stainability of *Polygonatum* in Japan, pollen grains were taken from anthers fixed in 70% ethanol, placed on a glass slide, then stained with a drop of lactophenol in cotton blue solution. I judged well-stained pollen grains as being fertile and faintly or hardly stained pollen grains as being sterile.

## Results and Discussion

### New or remarkable observations

*Polygonatum*  $\times$  *desoulavyi*, *P.*  $\times$  *domonense* and *P.*  $\times$  *azegamii*

According to Satake (1982), *Polygonatum cryptanthum* H. Lév. & Vaniot, *P. involucratum* (Franch. & Sav.) Maxim., *P. desoulavyi* var. *azegamii* Ohwi, *P. desoulavyi* var. *yezoense*, *P. domonense* Satake and *P. miserum* Satake are taxa in Japan with herbaceous bracts. *Polygonatum cryptanthum* and *P. involucratum* have oval to narrowly ovate bracts that are consistently inserted at the base of the pedicel. The remaining four taxa have broadly lanceolate to minutely filiform bracts that are inserted anywhere from the apex to the base of the pedicel. I consider the latter four to be hybrids. Further, I consider that *P. miserum* cannot be distinguished from *P. desoulavyi* var. *yezoense* at any rank. Thus, besides *P. cryptanthum* and *P. involucratum*, I recognize *P.*  $\times$  *desoulavyi* (= *P. desoulavyi* var. *yezoense* = *P. miserum*), *P.*  $\times$  *domonense* and *P.*  $\times$  *azegamii* (Ohwi) M. N. Tamura (= *P. desoulavyi* var. *azegamii*) as taxa or nothotaxa with herbaceous

bracts in Japan.

In *Polygonatum*  $\times$  *desoulavyi*, *P.*  $\times$  *domonense* and *P.*  $\times$  *azegamii*, the shape and size of the bracts (Fig. 1) and their position on the pedicel is variable and unstable within each nothotaxon. The distribution patterns of the processes and hairs on the filaments of these nothotaxa form a mosaic (Tamura 1991). Their karyotypes contain unpaired chromosomes and are thus heterogeneous in composition (Tamura 1990a). Their pollen stainability is low, ranging from 23% to 40%, in contrast to high pollen stainability, ranging from 74% to 98%, in other species of *Polygonatum* in Japan (Table 1). This evidence confirms that *P.*  $\times$  *desoulavyi*, *P.*  $\times$  *domonense* and *P.*  $\times$  *azegamii* are undoubtedly hybrids.

The differences in the karyotypes of the species of *Polygonatum* in Japan are often great, while variation within each species is slight (Tamura 1990a). It is more or less easy to identify species based only on karyotype information, and karyotype analysis is a useful approach for speculating on the parents of the nothospecies. Based on the karyotype data of Tamura (1990a) and those obtained in the

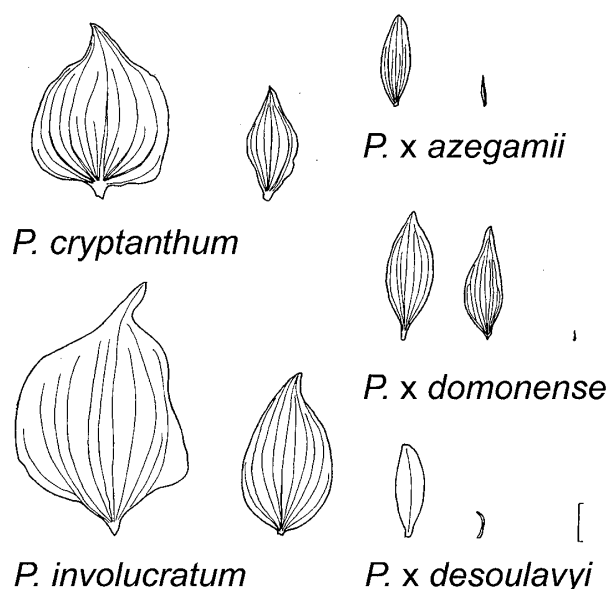


FIG. 1. Bracts of *Polygonatum* in Japan. *P. cryptanthum* from Tsushima; *P. involucratum* from Central Honshu; *P. desoulavyi* from Nagano Pref.; *P. x domonense* from Tohoku District; *P. x azegamii* from Tokyo. Bar = 5 mm.

TABLE 1. Pollen stainability of *Polygonatum* with lactophenol in cotton blue solution. "n/a" indicates "not available".

Taxa	Number of examined pollen grains (A)	Number of fertile pollen grains (B)	Number of sterile pollen grains	B/A (%)	Localities
<i>P. amabile</i>	329	244	85	74	Saga Pref., Kyushu, Japan
<i>P. ×azegamii</i>	508	117	391	23	Tokyo, Honshu, Japan
<i>P. cryptanthum</i>	500	467	33	93	Tsushima Isls., Nagasaki Pref., Japan
<i>P. ×desoulavyi</i>	521	210	311	40	Nagano Pref., Honshu, Japan
<i>P. ×domonense</i>	513	172	341	34	Yamagata Pref., Honshu, Japan
<i>P. falcatum</i>					
var. <i>falcatum</i>	547	488	59	89	Mie Pref., Honshu, Japan
var. <i>hyugaense</i>	684	566	118	83	Kumamoto Pref., Kyushu, Japan
var. <i>trichosantherum</i>	562	551	11	98	Nagasaki Pref., Kyushu, Japan
<i>P. humile</i>	609	471	138	77	Shiga Pref., Honshu, Japan
<i>P. inflatum</i>	537	492	45	92	Hiroshima Pref., Honshu, Japan
<i>P. involucrellum</i>	500	475	25	95	Shiga Pref., Honshu, Japan
<i>P. lasiantherum</i>					
var. <i>lasiantherum</i> (2x)	710	661	49	93	Hiroshima Pref., Honshu, Japan
var. <i>lasiantherum</i> (3x)	469	356	113	76	Okayama Pref., Honshu, Japan
var. <i>coreanum</i>	507	455	52	90	Cheju Isl., Korea
<i>P. macrantherum</i>	314	299	15	95	Toyama Pref., Honshu, Japan
<i>P. odoratum</i>					
var. <i>maximowiczii</i>	111	102	9	92	Abashiri, Hokkaido, Japan
var. <i>pluriflorum</i> (2x)	663	625	38	94	Yamanashi Pref., Honshu, Japan
var. <i>pluriflorum</i> (3x)	42	38	4	90	Yamanashi Pref., Honshu, Japan
var. <i>thunbergii</i>	n/a	n/a	n/a	n/a	n/a
<i>P. ×tamaense</i>	n/a	n/a	n/a	n/a	n/a

present study (Fig. 2), in addition to gross-morphological characteristics, it is safely presumed that *P. ×desoulavyi*, *P. ×domonense* and *P. ×azegamii* are hybrid derivatives between *P. humile* Fisch. ex Maxim. and *P. involucrellum*, between *P. involucrellum* and *P. lasiantherum* Maxim., and between *P. falcatum* and *P. involucrellum*, respectively.

*Polygonatum miserum* from Honshu has usually been recognized as distinct from *P. desoulavyi* var. *yezoense* of Hokkaido. Both of them have proven to be hybrids between *P. humile* and *P. involucrellum* and I include them in *P. ×desoulavyi*. In Japan, *P. miserum* tends to have more prominently papillose filaments and to be smaller than *P. desoulavyi* var. *yezoense*. On the Korean Peninsula, however, plants with prominently papillose filaments are taller, and are sometimes sympatric with

plants bearing less prominently papillose filaments. It is difficult to distinguish *P. miserum* from *P. desoulavyi* var. *yezoense*. The smaller size of *P. miserum* in comparison to *P. desoulavyi* var. *yezoense* possibly reflects the smaller size of *P. humile* on Honshu, one of the putative parents of *P. miserum*, in comparison to *P. humile* in Hokkaido, one of the putative parents of *P. desoulavyi* var. *yezoense*.

#### *Polygonatum nipponicum* and *P. ibukiense*

The identities of *Polygonatum nipponicum* Makino and *P. ibukiense* (Makino) Makino have long been discussed. The latter was first described as *Polygonatum periballanthus* Makino var. *ibukiense* Makino in 1898 based on plant(s) from Mt. Ibuki, Shiga Pref., Japan. Makino (1903) then described



FIG. 2. Somatic chromosomes of *Polygonatum*  $\times$  *desoulavyi* from Hokkaido, Japan (= *P. desoulavyi* var. *yezoense*). Bar = 5  $\mu$ m. This karyotype consists of unpaired chromosomes and thus it is heterogeneous in composition.

*Polygonatum nipponicum* based on plant(s) from Fukushima Pref., Japan. Makino in 1907 raised var. *ibukiense* to specific rank and reduced *P. nipponicum* to a synonym of *P. ibukiense*.

Since the type specimen of *Polygonatum nipponicum* is unknown, as Okuyama (1936) referred to, and the illustration of *P. periballanthus* var. *ibukiense* ambiguous, the taxonomy of *P. nipponicum* and *P. ibukiense* is controversial. Okuyama (1936) did not accept the treatment of Makino (1907), in which *P. nipponicum* was regarded as conspecific with *P. ibukiense*. Ohwi (1937) sug-

gested that *P. nipponicum* was similar to (or conspecific) with *P. inflatum* Kom. Satake (1942) agreed with Ohwi's opinion on *P. nipponicum*, and further suggested that *P. ibukiense* was conspecific with *P. cryptanthum*, although he treated *P. nipponicum* and *P. ibukiense* as doubtful species. Kitamura (1964) considered *P. ibukiense* to be a mutant of *P. involucratum*.

If we take the distribution of *Polygonatum inflatum* and *P. cryptanthum* in addition to *P. nipponicum* and *P. ibukiense* into consideration, the suggestions of Ohwi (1937) and Satake (1942) are

unacceptable. The distribution of *P. inflatum* in Japan is restricted to western Honshu (Hiroshima Pref.), Shikoku and Kyushu, while *P. nipponicum* is in Fukushima Pref., eastern Honshu, which is remote from the distribution area of *P. inflatum*. *Polygonatum cryptanthum* in Japan is restricted to Tsushima and Mt. Abura (Murata & Tsutsui 1989) in Kyushu, while *P. ibukiense* is on Mt. Ibuki in Central Honshu, which is remote from Kyushu.

Makino's (1903) description of *Polygonatum nipponicum* and the description and illustrations of *P. periballanthus* var. *ibukiense* show that the bracts are 2–5 per inflorescence, and not always in accordance with number of flowers. This is also sometimes encountered in *P. × domonense* and *P. × azegamii* rather than in *P. inflatum*, *P. cryptanthum* and *P. involucratum*. *Polygonatum × domonense* has been collected from both Fukushima Prefecture (the locality of *P. nipponicum*) and Mt. Ibuki (the locality of *P. ibukiense*) in Shiga Pref. (Tamura 1990b), while *P. × azegamii* is restricted to Tokyo, Kanagawa, Yamanashi and Nagano Prefectures. Accordingly, I agree with Makino (1907) in respect of considering *P. nipponicum* to be conspecific with *P. ibukiense*, both of which correspond with *P. × domonense*. Since I have not located the type specimen of *P. nipponicum*, I have not been able to confirm this.

#### *Polygonatum amabile*

*Polygonatum amabile* Yatabe (1892) (Fig. 3) was reduced to *P. lasianthum* and treated as f. *amabile* (Yatabe) Makino in 1903. Kitamura (1964) and Satake (1982) did not formally recognize 'amabile' at any rank. While *P. amabile* and *P. lasianthum* appear to be related based on gross morphology and karyology (Tamura 1990a), I observed differences in the shape of the hairs on the filaments of the two species. The hairs of *P. amabile* have unique cell joints with globose swellings, while the hairs of *P. lasianthum* have normal cell joints without globose swellings (Tamura 1991). I agree with the original



FIG. 3. *Polygonatum amabile* Yatabe from Saga Pref., Kyushu, Japan.

treatment of Yatabe (1892) in which *P. amabile* was recognized as a species distinct from *P. lasianthum*.

#### *Polygonatum falcatum* var. *trichosantherum*

*Polygonatum trichosantherum* Koidz. was described in 1919 based on cultivated plants in the Koishikawa Botanical Garden of the University of Tokyo. Koidzumi (1919) described hairs on the filaments and abaxial surface of the perianth in the original description. Hara (1944), however, reported the hairs observed by Koidzumi to be mold. Hara nevertheless maintained *P. trichosantherum*, primarily because *P. trichosantherum* has wider leaves, smoother filaments and an earlier flowering period than *P. falcatum*. Almost all floristic authors in Japan (Ohwi 1953, Kitamura 1964, Satake 1982) followed Hara (1944). I could not, however, find clear gaps between *P. trichosantherum* and *P. falcatum* even in leaf width, filament surface and flowering period (see below) and I regard *P. trichosantherum* as

conspecific with *P. falcatum*.

Based on my observations, plants of *Polygonatum falcatum* with wider leaves, smoother filaments and earlier flowering period than typical *P. falcatum* of Honshu occur along the coastal regions of SW Shikoku, Kyushu, Amami Islands (also in mountains) and Tsushima, Japan, and on Cheju Isl. and southern islands of Jeollanam-do in Korea. I include *P. trichosantherum* within the range of morphological variation of the wide leaf type of *P. fal-*

*catum*. This finding may be confirmed phytogeographically, because *P. trichosantherum* is believed to occur at Cape Nomo in Kyushu (Hara 1944, Kitamura 1964, Ohwi 1965, Satake 1982). Since plants of *P. falcatum* (including *P. trichosantherum*) with wide leaves are localized at the south and west margins of distribution of *P. falcatum*, I recognize the wide leaf type as *P. falcatum* var. *trichosantherum* (Koidz.) M. N. Tamura (Fig. 4).

### Taxonomy

#### *Polygonatum* Mill.

*Polygonatum* Mill., Gard. Dict. Abr., ed. 4 (1754); Adans., Fam. Pl. 2: 54 (1763); Kunth, Enum. Pl. 5: 131 (1850); Baker in J. Linn. Soc., Bot. 14: 552 (1875); Benth. & Hook. f., Gen. Pl. 3: 768 (1883); Engl. in Nat. Pflanzenfam. 2 (5): 80 (1887); K. Krause in Nat. Pflanzenfam., ed. 2, 15a: 368 (1930); Y. C. Tang in Fl. Reipubl. Popularis Sin. 15: 52 (1978); C. Jeffrey in Kew Bull. 34: 437 (1980); M. N. Tamura in Bot. Jahrb. Syst. 115: 22 (1993); Conran & M. N. Tamura in Fam. Gen. Vasc. Pl. 3: 192 (1998); S. C.

Chen & M. N. Tamura in Fl. China 24: 223 (2000).

—Lectotype: *Polygonatum odoratum* (Mill.) Druce (Abramova 1975).

*Periballanthus* Franch. & Sav., Enum. Pl. Jap. 2: 524 (1878). —Type: *Periballanthus involucratus* Franch. & Sav. (= *Polygonatum involcratum* (Franch. & Sav.) Maxim.).

*Distribution*. Species 54; northern hemisphere from the subtropics to the subarctic.

### Key to Species, Nothospecies and Varieties of Japan

- 1a. Bracts present .....2
- 1b. Bracts absent .....7
- 2a. Bracts membranous, caducous; perianth pale green, adaxial surface partially pubescent ... 1. *P. inflatum*
- 2b. Bracts herbaceous, persistent; perianth white or cream, rarely greenish, often tipped with green, adaxial surface glabrous .....3
- 3a. Peduncles, pedicels, and veins on abaxial surface of bracts densely hispidulous; perianth 0.9–1.4 cm long; pistil shorter than stamens, ca. 1/2 as long as perianth ..... 9. *P. cryptanthum*
- 3b. Peduncles, pedicels, and veins on abaxial surface of bracts usually smooth, rarely irregularly covered with needle-like or conical processes; perianth (1.4–)1.6–2.6 cm long; pistil longer than stamens, nearly as long as perianth .....4
- 4a. Bracts oval to ovate, inserted at base of pedicel ..... 10. *P. involcratum*
- 4b. Bracts broadly lanceolate to minute filiform, inserted anywhere from apex to base of pedicel .....5
- 5a. Uniseriate hairs composed of 2–4 cells, sparsely distributed on upper, middle and lower portion of filaments; perianth (1.7–)1.9–2.2 cm long; annual elongation of rhizome ca. 2–4 cm ..... 12. *P. ×domonense*
- 5b. Uniseriate hairs composed of 2–3 cells, sparsely distributed on middle (and lower) portion of filaments, not on upper portion of filaments; perianth (1.4–)1.6–1.9(–2) cm long; annual elongation of rhizome ca. 4–15 cm .....6

- 6a. Needle-like, conical or triangle processes irregularly distributed on margin of bracts and veins of abaxial surface and margin of leaves; filaments always flattened; rhizome 1.5–3(–5) mm in diam., annual elongation ca. 6–15 cm; stem 12–30(–45) cm long ..... 11. *P. ×desoulavyi*
- 6b. Bracts and leaves smooth; filaments columnar or flattened; rhizome 5–7.5 mm in diam., annual elongation ca. 4–7 cm; stem 35–55 cm long ..... 13. *P. ×azegamii*
- 7a. Filaments with hairs; peduncles ascending, patent or reflexed ..... 8
- 7b. Filaments glabrous or with processes; peduncles strongly arcuate-recurved from base, pendulous ..... 11
- 8a. Basal adaxial surface of filaments papillose, with sparse short hairs; peduncles reflexed; leaves oblong-lanceolate ..... 8. *P. ×tamaense*
- 8b. Basal adaxial surface of filaments pubescent; peduncles ascending or spreading horizontally; leaves narrowly oblong to broadly elliptic ..... 9
- 9a. Leaves dark green to green, with a central longitudinal broad white space on upper surface; multicellular-uniseriate hairs on filaments with globose swellings at cell joints; flowers fragrant ..... 6. *P. amabile*
- 9b. Leaves green, without a central longitudinal broad white space on upper surface; multicellular-uniseriate hairs on filaments without swellings at cell joints; flowers odorless (5. *P. lasianthum*) ..... 10
- 10a. Upper portion of filaments loosely pubescent; flowers 1.4–2.4 cm long, (1–)2–3(–4) per inflorescence ..... 5a. *P. lasianthum* var. *lasianthum*
- 10b. Upper portion of filaments glabrous; flowers 2.3–2.8 cm long, 1–2 per inflorescence ..... 5b. *P. lasianthum* var. *coreanum*
- 11a. Veins on abaxial surface of leaves hispidulous; abaxial surface of leaves green; stem erect, (8.5–)10–45 (–54) cm long; rhizome terete, (1.5–)3–4(–5) mm in diam. .... 4. *P. humile*
- 11b. Veins on abaxial surface of leaves not hispidulous but papillose or smooth; abaxial surface of leaves more or less glaucous; stem arching, 25–150 cm long; rhizome terete, moniliform or zigzag, 4–30 mm in diam. .... 12
- 12a. Stem angled except at base (3. *P. odoratum*) ..... 13
- 12b. Stem terete ..... 15
- 13a. Veins on abaxial surface of leaves nearly smooth ..... 3a. *P. odoratum* var. *pluriflorum*
- 13b. Veins on abaxial surface of leaves papillose ..... 14
- 14a. Annual elongation of rhizome 4.5–10 cm; stem 30–80 cm long ..... 3b. *P. odoratum* var. *thunbergii*
- 14b. Annual elongation of rhizome 1.7–3(–4.5) cm; stem 60–150 cm long ..... 3c. *P. odoratum* var. *maximowiczii*
- 15a. Flowers campanulate-funnelform, 25–38 mm long; free part of filaments 7–10 mm long, thickened downward, basally verruculose, apically smooth; anthers 4.5–5.5 mm long; rhizome zigzag ..... 2. *P. macranthum*
- 15b. Flowers tubular, 17–23 mm long; free part of filaments 5–7 mm long, thickened upward, basally smooth, apically more or less papillose or verruculose; anthers 2.5–3 mm long; rhizome moniliform (7. *P. falcatum*) ..... 16
- 16a. Leaves lanceolate-ovate to narrowly ovate, veins on abaxial surface nearly smooth; free part of filaments apically weakly papillose or verruculose ..... 7c. *P. falcatum* var. *trichosantherum*
- 16b. Leaves linear-lanceolate to lanceolate-oblong, veins on abaxial surface papillose to nearly smooth; free part of filaments apically moderately to strongly papillose or verruculose ..... 17
- 17a. Free part of filaments apically moderately papillose or verruculose; veins on abaxial surface of leaves papillose to nearly smooth ..... 7a. *P. falcatum* var. *falcatum*
- 17b. Free part of filaments apically strongly papillose or verruculose; veins on abaxial surface of leaves papillose ..... 7b. *P. falcatum* var. *hyugaense*

# 1. *Polygonatum inflatum* Kom.

*P. inflatum* Kom. in Trudy Imp. S.-Peterburgsk. Bot. Sada  
18: 442 (1901); Satake in J. Jap. Bot. 18: 34 (1942);

Ohwi, Fl. Jap.: 314 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 112, fig. 83/8–9 (1964);  
Y. C. Tang in Fl. Reipubl. Popularis Sin. 15: 60, t. 19/4–5 (1978); C. Jeffrey in Kew Bull. 34: 442

(1980); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46 (1982); Y. N. Lee, Fl. Korea: 923, fig. 2917 (1996); S. C. Chen & M. N. Tamura in Fl. China 24: 225 (2000). — **Lectotype**: Korea, Samsu District, Amnok-gun, 6 Jul. 1897, *V. L. Komarov s.n.* (LE, photo K!), **hic designatus**. *Other syntypes*: China, Manchuria, Kirin, Loelin, 30 Aug. 1896, *V. L. Komarov s.n.* (LE, photo K!); Manchuria, 8 Sep. 1897, *V. L. Komarov s.n.* (LE, photo K!).

*P. virens* Nakai in Repert. Spec. Nov. Regni Veg. 13: 247 (1914). — Type: Korea, Mt. Chiri, 30 Jun. 1913, *T. Nakai 75* (holo- TI!, photo K!).

*P. inflatum* Kom. var. *rotundifolium* Hatus. in Bull. Kyushu Imp. Univ. Forests 5: 232 (1934). — Type: not designated.

*Japanese name*. Midori-youraku.

*Chromosome number*.  $2n = 22$  (Tamura 1990a).

*Distribution*. Japan, Korea and NE China.

Japan: Honshu (Hiroshima Pref.), Shikoku and Kyushu. Deciduous forests, forest margins, grasslands.

*Note*. *Polygonatum inflatum* is rare in Japan, but comparatively common in Korea.

## 2. *Polygonatum macranthum* (Maxim.) Koidz.

*P. macranthum* (Maxim.) Koidz. in Bot. Mag. (Tokyo) 33: 111 (1919); H. Hara in J. Jap. Bot. 20: 100 (1944); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 111 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 40/4 (1982). — *P. giganteum* A. Dietr. var. *macranthum* Maxim. in Mélanges Biol. Bull. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg 11: 852 (1883). — Syntypes: Japan, Honshu, Hakone, 7/19 Oct. 1862, *Maximowicz s.n.* (LE, photo K!); Honshu, Mt. Fuji, *Tschonoski s.n.* (LE); Japan, Kyushu, Higo-san, anno 1863, *Maximowicz s.n.* (K!, LE).

*P. silviculum* Makino in J. Jap. Bot. 3: 26 (1926). — Type: Japan, Honshu, Prov. Hitachi (Ibaraki Pref.), Mt. Tsukuba, *T. Makino s.n.* (n.v.).

*P. sadoense* Nakai ex Koidz., Fl. Symb. Orient.-Asiat.: 34 (1930). — Syntypes: Japan, Niigata Pref., Sado Isl., 30 Jun. 1888, *Faurie 2567* (P, photo K!); Japan, Kominato, *Faurie s.n.* (P).

*P. iyoense* Nakai ex F. Maek. in Bot. Mag. (Tokyo) 46: 584, fig. 12 (1932). — Type: Japan, Shikoku, Prov.

Iyo (Ehime Pref.), Mt. Onigajyo, Jun. 1926, *T. Nakai s.n.* (holo- TI!, photo K!).

*P. stenanthum* auct. non Nakai: C. Jeffrey in Kew Bull. 34: 450 (1980), p.p. excl. typ.

*Japanese name*. Oh-naruko-yuri.

*Chromosome number*.  $2n = 22$ . B chromosomes are sometimes observed (Tamura 1990a).

*Distribution*. Japan, endemic.

Japan: Hokkaido, Honshu, Shikoku and Kyushu. Deciduous forests, forest margins, *Cryptomeria* plantations.

*Note*. Jeffrey (1980) used *Polygonatum stenanthum* instead of *P. macranthum* as the name for this species. *Polygonatum macranthum* should be used in the concept of Hara (1944), Ohwi (1953), Kitamura (1964) and Satake (1982). From characteristics of the filaments, the type specimen of *P. stenanthum* does not belong to *P. macranthum* but to *P. falcatum*.

## 3. *Polygonatum odoratum* (Mill.) Druce

*P. odoratum* (Mill.) Druce in Ann. Scott. Nat. Hist. 60: 226 (1906); H. Hara in J. Jap. Bot. 20: 97 (1944); Y. C. Tang in Fl. Reipubl. Popularis Sin. 15: 61, t. 19/1–3 (1978); C. Jeffrey in Kew Bull. 34: 448 (1980); S. C. Chen & M. N. Tamura in Fl. China 24: 226 (2000). — *Convallaria odorata* Mill., Gard. Dict., ed. 8, *Convallaria* no. 4 (1768).

*Convallaria polygonatum* L., Sp. Pl.: 315 (1753); Thunb., Fl. Jap.: 142 (1784). — *P. officinale* All., Fl. Pedem. 1: 131 (1785); Maxim. in Bull. Acad. Imp. Sci. Saint-Petersbourg 29: 206 (1884); Hegi, Ill. Fl. Mitt.-Eur. 2: 270, figs. 381–382 (1909); Knorr in Fl. URSS 4: 463, tab. 28/1–1a (1935). — **Lectotype**: *Herb. Linnaei 436-3* (LINN, microfiche!, Jeffrey 1980).

*P. vulgare* Desf. in Ann. Mus. Natl. Hist. Nat. 9: 49 (1807).

### 3a. var. *pluriflorum* (Miq.) Ohwi

*P. odoratum* var. *pluriflorum* (Miq.) Ohwi in Bull. Natl. Sci. Mus., Tokyo 26: 7 (1949); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 111, fig. 83/5, pl. 29/192 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 40/1–



2 (1982); Y. N. Lee, Fl. Korea: 924, fig. 2922 (1996). — *P. officinale* All. var. *pluriflorum* Miq., Prolus. Fl. Jap.: 312 (1867).

*P. vulgare* Desf. var. *macranthum* Hook. f. in Bot. Mag. 100: tab. 6133 (1874). — *P. officinale* All. var. *macranthum* (Hook. f.) Hua in J. Bot. (Morot) 6: 395 (1892). — *P. odoratum* (Mill.) Druce var. *macranthum* (Hook. f.) H. Hara in J. Jap. Bot. 20: 99 (1944). — Type: Japan, cult. Kew, May 1874 (holo-K!).

*P. japonicum* C. Morren & Decne. var. *variegatum* Nakai in Bot. Mag. (Tokyo) 38: 299 (1924). — Type: Japan, cult. Tokyo, anno 1862, *Maximowicz s.n.* (BM, GH, K!).

*P. quelpaertense* Ohwi in J. Jap. Bot. 13: 443 (1937). — *P. odoratum* (Mill.) Druce var. *quelpaertense* (Ohwi) H. Hara in J. Jap. Bot. 20: 99 (1944). — Type: Korea, Cheju Isl., May 1935, *J. Ohwi 9265* (holo-KYO!).

*P. planifilum* Kitag. & Hid. Takah. in J. Jap. Bot. 46: 307 (1971). — Type: Japan, Honshu, Gunma Pref., Mt. Jizo-dake in Mts. Akagi, 1 Jul. 1967, *H. Takahashi s.n.* (holo-KPM!).

*P. odoratum* (Mill.) Druce var. *japonicum* (C. Morren & Decne.) H. Hara in J. Jap. Bot. 20: 98 (1944), p.p. excl. typ.

*Japanese name.* Amadokoro.

*Chromosome number.*  $2n = 20$ . Triploids with  $2n = 30$  are rarely observed (Tamura 1990a).

*Distribution.* Japan and Korea.

Japan: Hokkaido, Honshu, Shikoku and Kyushu. Deciduous forests, forest margins, grasslands, marshes.

### 3b. var. *thunbergii* (C. Morren & Decne.) H. Hara

*P. odoratum* var. *thunbergii* (C. Morren & Decne.) H. Hara in J. Jap. Bot. 20: 98 (1944); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Coll. III. Herb. Pl. Jap. 3: 111 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Harb. Pl. 1: 46 (1982). — *P. thunbergii* C. Morren & Decne. in Ann. Sci. Nat. Bot., ser. 2, 2: 312 (1834). — *P. giganteum* A. Dietr. var. *thunbergii* (C. Morren & Decne.) Maxim. in Mélanges Biol. Bull. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg 11: 851 (1883). — Type: Japan, cult. Paris, from Siebold (n.v.).

*P. japonicum* C. Morren & Decne. in Ann. Sci. Nat. Bot., ser. 2, 2: 311 (1834). — *P. officinale* All. var. *japonicum* (C. Morren & Decne.) Miq., Prolus. Fl. Jap.: 312 (1867). — *P. vulgare* Desf. var. *japonicum* (C. Morren & Decne.) Franch. & Sav., Enum. Pl. Jap. 2: 54 (1877). — *P. odoratum* (Mill.) Druce var. *japonicum* (C. Morren & Decne.) H. Hara in J. Jap. Bot. 20: 98 (1944), p.p. excl. syn. — Type: Japan, cult. Paris, from Siebold (n.v.).

*Japanese name.* Yama-amadokoro.

*Chromosome number.*  $2n = 20$  (Tamura 1990a).

*Distribution.* Japan, endemic.

Japan: Honshu (coast of the Sea of Japan, sometimes inland), Shikoku (Ehime Pref.) and Kyushu (Iki Isl.). Deciduous forests, forest margins, grasslands, sand dunes.

### 3c. var. *maximowiczii* (F. Schmidt) Koidz.

*P. odoratum* var. *maximowiczii* (F. Schmidt) Koidz. in Bot. Mag. (Tokyo) 33: 111 (1919); H. Hara in J. Jap. Bot. 20: 99 (1944); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Col. III. Herb. Pl. Jap. 3: 111 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 40/3 (1982). — *P. maximowiczii* F. Schmidt, Reis. Amur-Land., Bot.: 185 (1868); Knorring in Fl. URSS 4: 464 (1935). — *P. officinale* All. var. *maximowiczii* (F. Schmidt) Maxim. in Mélanges Biol. Bull. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg 11: 847 (1883). — Type: Russia, Sakhalin, *Weyrich s.n.* (holo-LE, n.v.).

*P. hondoense* Nakai ex Koidz., Fl. Symb. Orient.-Asiat.: 34 (1930). — Syntypes: Japan, Honshu, Aomori, 8 Jun. 1887, *Faurie 440* (K!, P); Aomori, anno 1889, *Faurie 142* (P); Japan, Hokkaido, Sapporo, Sep. 1886, *Faurie 1349* (K, P); Hokkaido, Otaru, 23 May 1889, *Faurie 244* (KYO!, P).

*Japanese name.* Oh-amadokoro.

*Chromosome number.*  $2n = 20$  (Tamura 1990a).

*Distribution.* Japan and Russia (Sakhalin and Ussuri).

Japan: Hokkaido and Honshu (Tohoku District). Grasslands, deciduous forests, forest margins.

**4. *Polygonatum humile* Fisch. ex Maxim.**

*P. humile* Fisch. ex Maxim. in Mém. Acad. Imp. Sci. St.-Petersbourg Divers Savans 9: 275 (1859); Knorring in Fl. URSS 4: 463, tab. 28/6-6a (1935); H. Hara in J. Jap. Bot. 20: 97 (1944); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 110, fig. 83/1-3, pl. 29/190 (1964); Y. C. Tang in Fl. Reipubl. Popularis Sin. 15: 60 (1978); C. Jeffrey in Kew Bull. 34: 447 (1980); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 39/4 (1982); Y. N. Lee, Fl. Korea: 922, fig. 2915 (1996); S. C. Chen & M. N. Tamura in Fl. China 24: 226 (2000). — *P. officinale* All. var. *humile* (Fisch. ex Maxim.) Baker in J. Linn. Soc., Bot. 14: 554 (1875). — Syntypes: Russia, Dahuria, Nerchinsk, *Sosnin s.n.* (LE, photo K!); *Pfluggradh s.n.* (LE); Russia, Amur, *Orlow 50* (LE, photo K!).

*P. humillimum* Nakai in Repert. Spec. Nov. Regni Veg. 13: 248 (1914). — Type: Korea, Cheju Isl., May 1911, *Taquet 5206* (holo- TI!, photo K!; iso- E, photo K!).

*Japanese name.* Hime-izui.

*Chromosome number.*  $2n = 20$  (Tamura 1990a).

*Distribution.* Japan, Korea, NE China, Mongolia and Russia (Far East to Siberia).

Japan: Hokkaido, Honshu (Tohoku District to Mt. Ibuki, Kinki District) and Kyushu (Mt. Hiko). Grasslands, sand dunes.

*Note.* *Polygonatum humile* is disjunctly distributed in Honshu: mostly on the coast in Tohoku District; in alpine meadows in Chubu and Kinki Districts.

**5. *Polygonatum lasianthum* Maxim.**

*P. lasianthum* Maxim. in Bull. Acad. Imp. Sci. Saint-Petersbourg 29: 209 (1884); H. Hara in J. Jap. Bot. 20: 96 (1944); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 110, fig. 83/4, pl. 29/191 (1964); C. Jeffrey in Kew Bull. 34: 443 (1980); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 39/3 (1982). — Syntypes: Japan, Hokkaido, near Hakodate, *Small s.n.* (LE); Hokkaido, near Lake Konoma, *Maximowicz s.n.* (LE); Japan, Honshu, Mt. Fuji, anno 1864 & Prov. Nambu, anno 1865, *Tschonoski s.n.* (BM, GH, K!, LE).

**5a. var. *lasianthum***

*P. akiense* Nakai MS. in herb. University of Tokyo.

*Japanese name.* Miyama-naruko-yuri.

*Chromosome number.*  $2n = 20$ . Triploids with  $2n = 30$  are rarely observed (Tamura 1990a).

*Distribution.* Japan, endemic.

Japan: Hokkaido, Honshu, Shikoku and Kyushu. Deciduous forests, forest margins, *Cryptomeria* plantations.

**5b. var. *coreanum* Nakai**

*P. lasianthum* var. *coreanum* Nakai in Repert. Spec. Nov. Regni Veg. 13: 247 (1914); Y. N. Lee, Fl. Korea: 924, fig. 2920 (1996). — **Lectotype:** Korea, Mt. Chiri, 6 Jul. 1913, *T. Nakai 673* (TI!, photo K!, **hic designatus**). Other syntypes: Korea, Wang Isl., 18 Jun. 1913, *T. Nakai 613* (TI!, photo K!); Wang Isl., 20 Jun. 1913, *T. Nakai 818* (TI!, photo K!).

*P. taquetii* H. Lév. & Vaniot in Repert. Spec. Nov. Regni Veg. 5: 282 (1908). — Type: Korea, Cheju Isl., Mt. Halla, Jun. 1907, *U. Faurie 2115* (holo- E, photo K!; iso- BM).

*P. petiolatum* H. Lév. in Repert. Spec. Nov. Regni Veg. 11: 33 (1912). — Type: Korea, Cheju Isl., 25 Aug. 1911, *Taquet 5207* (holo- E, photo K!).

*Japanese name.* Chosen-naruko-yuri.

*Chromosome number.*  $2n = 20$  (Tamura 1990a).

*Distribution.* Japan and Korea.

Japan: Kyushu (Tsushima). Deciduous forests, forest margins.

*Note.* Formerly, *Polygonatum lasianthum* on Tsushima was identified as var. *lasianthum* (Hara 1944).

**6. *Polygonatum amabile* Yatabe (Fig. 3).**

*P. amabile* Yatabe in Bot. Mag. (Tokyo) 6: 279, pl. 8 (1892). — *P. lasianthum* Maxim. f. *amabile* (Yatabe) Makino in Bot. Mag. (Tokyo) 17: 115 (1903); H. Hara in J. Jap. Bot. 20: 96 (1944); Ohwi, Fl. Jap.: 313 (1953). — **Lectotype:** Japan, cult. Bot. Gard., Koishikawa, Univ. Tokyo, anno 1884 (TI!, photo K!, Jeffrey 1980).

*Japanese name.* Hime-naruko-yuri.

*Chromosome number.*  $2n = 20$  (Tamura 1990a).

*Distribution.* Japan, endemic.

Japan: Honshu (Tochigi Pref. or Nagano Pref.) and Kyushu (Saga Pref.). Forests.

## 7. *Polygonatum falcatum* A. Gray

*P. falcatum* A. Gray in Mem. Amer. Acad. Arts, n.s. 6: 414 (1859); H. Hara in J. Jap. Bot. 20: 101 (1944); Ohwi, Fl. Jap.: 314 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 111, fig. 83/6-7, pl. 29/193 (1964); C. Jeffrey in Kew Bull. 34: 445 (1980); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 41/1 (1982); Y. N. Lee, Fl. Korea: 922, fig. 2914 (1996). — *P. giganteum* A. Dietr. var. *falcatum* (A. Gray) Maxim. in Mélanges Biol. Bull. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg 11: 851 (1883). — Type: Japan, Honshu, Shizuoka Pref., Shimoda, 1853-1856, C. Wright s.n. (iso- GH, photo K!).

### 7a. var. *falcatum*

*P. stenanthum* Nakai in Bot. Mag. (Tokyo) 27: 34 (1913). — Type: Korea, 1906, Faurie s.n. (holo- TI!).  
*P. umbellatum* H. Lév. in Repert. Spec. Nov. Regni Veg. 11: 495 (1913). — Type: Korea, Cheju Isl., 10 Jun. 1910, Taquet 4055 (holo- E, photo K!; iso- LE).  
*P. tenuiflorum* Koidz. in Bot. Mag. (Tokyo) 33: 112 (1919). — *P. falcatum* A. Gray var. *tenuiflorum* (Koidz.) Ohwi in Bull. Natl. Sci. Mus., Tokyo 33: 68 (1953). — Type: Japan, Honshu, Prov. Suwo (Yamaguchi Pref.), Yoshiki-gun, Ohuchi-mura, Ono, 6 May 1894, T. Nakai 97 (holo- TI!, photo K!).  
*P. kiotense* N. Yonez. in Acta Phytotax. Geobot. 49: 19 (1998). — Type: Japan, Honshu, Kyoto-shi, 20 May 1996, N. Yonezawa 25000 (holo- KYO!).  
*Convallaria multiflora* auct. non L.: Thunb., Fl. Jap.: 142 (1784).  
*P. koreanum* Nakai MS. in herb. University of Tokyo.

*Japanese name.* Naruko-yuri.

*Chromosome number.*  $2n = 18$  (Tamura 1990a).

*Distribution.* Japan and Korea.

Japan: Honshu (Kanto to Chugoku Districts), Shikoku and Kyushu. Deciduous forests, forest margins, evergreen forests, *Cryptomeria* plantations.

*Note.* Leaf shape is variable in *Polygonatum falcatum* var. *falcatum*. Narrow leaved plants are often encountered in the Kanto District and in the mountains of Shikoku. The type specimen of *P. tenuiflorum* from Yamaguchi Pref., as well as the types of *P. stenanthum* and *P. umbellatum* from Korea, have wide leaves and represent intermediates between vars. *falcatum* and *trichosanthum* in leaf width. *Polygonatum kiotense* is probably a mutant of var. *falcatum*.

### 7b. var. *hyugaense* Hiyama

*P. falcatum* var. *hyugaense* Hiyama in J. Jap. Bot. 32: 164 (1957); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 112 (1964); Ohwi, Fl. Jap. rev. ed.: 368 (1965); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46 (1982). — Type: Japan, Kyushu,



FIG. 4. *Polygonatum falcatum* A. Gray var. *trichosanthum* (Koidz.) M. N. Tamura from Tsushima, Japan.

Prov. Hyuga (Miyazaki Pref.), Kawaminami-mura, 27 Apr. 1950, *M. Nagasawa s.n.* (holo- TNS!; iso- TNS!).

*Japanese name.* Hyuga-naruko-yuri.

*Chromosome number.*  $2n = 18$ . B chromosomes are sometimes observed (Tamura 1990a).

*Distribution.* Japan, endemic.

Japan: Kyushu (mountains). Deciduous forests, forest margins.

**7c. var. *trichosanthum* (Koidz.) M. N. Tamura, stat. nov. (Fig. 4)**

Basionym: *Polygonatum trichosanthum* Koidz. in Bot. Mag. (Tokyo) 33: 112 (1919); H. Hara in J. Jap. Bot. 20: 101 (1944); Ohwi, Fl. Jap.: 313 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 112 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46 (1982). — Type: Japan, cult. Bot. Gard., Koishikawa, Univ. Tokyo, *J. Matsumura s.n.* (holo- TI!, photo K!).

*Japanese name.* Maruba-ousei.

*Chromosome number.*  $2n = 18$  (Tamura 1990a).

*Distribution.* Japan and Korea.

Japan: SW Shikoku (coastal regions), Kyushu (coastal regions) and Ryukyu (Amami Islands). Evergreen forests.

**8. *Polygonatum* × *tamaense* H. Hara**

*P. ×tamaense* H. Hara in J. Jap. Bot. 28: 312 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 111 (1964); C. Jeffrey in Kew Bull. 34: 444 (1980). — Type: Japan, Honshu, Prov. Musashi (Tokyo), Kinugasa between Hikawa and Mt. Mutsuishi, 14 Jun. 1953, *S. Kurosawa s.n.* (holo- TI!, photo K!).

Presumption: *P. falcatum* A. Gray × *P. lasianthum* Maxim.

*Japanese name.* Tama-naruko-yuri.

*Chromosome number.* unknown.

*Distribution.* Japan, endemic.

Japan: Honshu (Tokyo). Forests.

**9. *Polygonatum cryptanthum* H. Lév. & Vaniot**

*P. cryptanthum* H. Lév. & Vaniot in Repert. Spec. Nov. Regni Veg. 5: 282 (1908); Ohwi in J. Jap. Bot. 13: 442 (1937); Satake in J. Jap. Bot. 18: 35 (1942); Ohwi, Fl. Jap.: 314 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 112 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 46, pl. 41/4 (1982). — Type: Korea, Mokpo, May 1907, *U. Faurie 2123* (holo- E, photo K!; iso- BM, KYO!).

*P. fauriei* H. Lév. & Vaniot in Repert. Spec. Nov. Regni Veg. 5: 282 (1908). — Type: Korea, Cheju Isl., Mt. Halla, Jun. 1907, *U. Faurie 2121* (holo- E, photo K!; iso- BM, KYO!).

*Japanese name.* Usugi-waniguchi-so.

*Chromosome number.*  $2n = 18$  (Tamura 1990a).

*Distribution.* Japan and Korea.

Japan: Kyushu (Mt. Abura, Fukuoka Pref., and Tsushima). Grasslands, forest margins, *Pinus* forests.

**10. *Polygonatum involucratum* (Franch. & Sav.) Maxim.**

*P. involucratum* (Franch. & Sav.) Maxim. in Mélanges Biol. Bull. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg 11: 844 (1883); Knorring in Fl. URSS 4: 460, tab. 28/7-7a (1935); Satake in J. Jap. Bot. 18: 36 (1942); Ohwi, Fl. Jap.: 315 (1953); Kitam. in Kitamura *et al.*, Col. Ill. Herb. Pl. Jap. 3: 112, pl. 29/194 (1964); Y. C. Tang in Fl. Reipubl. Popularis Sin. 15: 58, t. 18/1-2 (1978); C. Jeffrey in Kew Bull. 34: 441 (1980); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 47, pl. 41/3 (1982); Y. N. Lee, Fl. Korea: 923, fig. 2918 (1996); S. C. Chen & M. N. Tamura in Fl. China 24: 225 (2000). — *Periballanthus involucratum* Franch. & Sav., Enum. Pl. Jap. 2: 524 (1878). — Type: Japan, Honshu, Yedo (Tokyo), *Savatier s.n.* (holo- P, photo K!).

*Polygonatum platyphyllum* Franch. in J. Bot. (Morot) 4: 318 (1890). — Type: China, Hopei, May 1888, *Bodinier 65* (holo- P, photo K!; iso- E).

*P. periballanthus* Makino in Bot. Mag. (Tokyo) 12: 228 (1898), nom. illegit., superfl.

*Japanese name.* Waniguchi-so.

*Chromosome number.*  $2n = 18$  (Tamura 1990a).

*Distribution.* Japan, Korea, NE China and

Russia (Ussuri).

Japan: SW Hokkaido, Honshu (Tohoku District to Mt. Ibuki, Kinki District, and Mt. Takasu, Chugoku District) and Kyushu. Deciduous forests.

### 11. *Polygonatum* × *desoulavyi* Kom.

*P. desoulavyi* Kom. in Komarov & Klobukova-Alisova, Key Pl. Far East. USSR 1: 378, tab. 116/2 & 4 (1931); Kom. in Izv. Bot. Sada Akad. Nauk SSSR 30: 199 (1932); Knorring in Fl. URSS 4: 463 (1935); Ohwi in J. Jap. Bot. 13: 443 (1937); Satake in J. Jap. Bot. 18: 36 (1942); Y. C. Tang in Fl. Reipubl. Popularis Sin. 15: 58 (1978); S. C. Chen & M. N. Tamura in Fl. China 24: 225 (2000). — **Lectotype:** Russia, Russkii Island, 7 Jun. 1922, *N. A. Desoulavy 143* (LE, microfiche!, **hic designatus**, see note below).

*P. mediobracteatum* Ohwi in J. Jap. Bot. 13: 443 (1937). — *P. desoulavyi* Kom. var. *mediobracteatum* (Ohwi) Satake in J. Jap. Bot. 18: 36 (1942). — Type: Korea, Gangwon-do, Mt. Keumgang, Jun. 1932, *J. Ohwi s.n.* (holo- KYO!).

*P. mediobracteatum* Ohwi var. *yezoense* Miyabe & Tatew. in Trans. Sapporo Nat. Hist. Soc. 15: 47 (1937). — *P. desoulavyi* Kom. var. *yezoense* (Miyabe & Tatew.) Satake in J. Jap. Bot. 19: 46 (1943); Ohwi, Fl. Jap.: 314 (1953); Kitam. in Kitamura *et al.*, Col. III. Herb. Pl. Jap. 3: 112 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 47, pl. 42/1 (1982); Y. N. Lee, Fl. Korea: 922 (1996). — Type: Japan, Hokkaido, Prov. Ishikari, Makomanai, 14 Jun. 1937, *M. Hara s.n.* (holo- SAPS, photo K!).

*P. miserum* Satake in J. Jap. Bot. 18: 37 (1942); Ohwi, Fl. Jap.: 314 (1953); Kitam. in Kitamura *et al.*, Col. III. Herb. Pl. Jap. 3: 112 (1964); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 47 (1982). — Type: Japan, Honshu, Prov. Shinano (Nagano Pref.), Azusayama, Jun. 1941, *D. Shimizu s.n.* (holo- TNS!).

*P. desoulavyi* Kom. var. *tobae* Hiyama MS. in Makino Herb., Tokyo Metropolitan Univ.

Presumption: *P. humile* Fisch. ex Maxim. × *P. involucratum* (Franch. & Sav.) Maxim.

**Japanese name.** Kongo-waniguchi-so (Ohwi 1937), Korai-waniguchi-so (Ohwi 1937), Ezo-waniguchi-so (Miyabe & Tatewaki 1937), Kowaniguchi-so (Satake 1942).

**Chromosome number.**  $2n = 19$  (Tamura 1990a, present study).

**Distribution.** Japan, Korea, China (Heilongjiang) and Russia (Ussuri).

Japan: SW Hokkaido and Honshu (Iwate, Yamanashi, Nagano and Shiga Prefs.). Deciduous forests, grasslands.

**Note.** Jeffrey (1980) reported *Desoulavy 142* to be the holotype of *Polygonatum desoulavyi*. I believe, however, that he meant lectotype instead of holotype, because Komarov (1932), which supplemented the protologue of Komarov (1931), cited specimens collected by Desoulavy on 7 June 1922, which include *Desoulavy 142* and *143*.

Komarov's protologue (1931) reported *Polygonatum desoulavyi* to have two shovel-like bracts, which are separated from each other. *Desoulavy 142*, however, has two bracts that are attached to each other at the base. I observed *Desoulavy 143* to have two shovel-like bracts that are separate from each other and therefore select *Desoulavy 143* to replace *Desoulavy 142* as the lectotype of *P. × desoulavyi*. *Desoulavy 142* is *P. involucratum*.

### 12. *Polygonatum* × *domonense* Satake

*P. domonense* Satake in J. Jap. Bot. 45: 4, figs. 1–2 (1970); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 47 (1982). — Type: Japan, Honshu, Yamagata Pref., Oguni-cho, Katadomon, 6 Jun. 1968, *D. Shimizu s.n.* (holo- TNS!).

Presumption: *P. involucratum* (Franch. & Sav.) Maxim. × *P. lasianthum* Maxim.

**Japanese name.** Domon-waniguchi-so.

**Chromosome number.**  $2n = 19$  (Tamura 1990a).

**Distribution.** Japan, endemic.

Japan: Honshu (Yamagata, Fukushima and Shiga Prefs.). Deciduous forests, grasslands.

**Note.** Satake (1970, 1982) considered the filaments of *Polygonatum × domonense* (= *P. domonense*) and *P. × azegamii* (= *P. desoulavyi* var. *azegamii*) to be filiform and flattened, respectively.

He recognized the diagnostic value of the filaments. I have noticed that the filaments of the two taxa vary from filiform to flattened, and therefore consider filament features to be of no diagnostic value in separating them.

**13. *Polygonatum* × *azegamii* (Ohwi) M. N. Tamura, stat. nov.**

Basionym: *Polygonatum desoulavyi* Kom. var. *azegamii* Ohwi, Fl. Jap. rev. ed.: 1439 & 369, t. 12 (1965); Satake in Satake *et al.*, Wild Fl. Jap. Herb. Pl. 1: 47, pl. 42/2 (1982). — Type: Japan, Honshu, Prov. Musashi (Tokyo), Minamitakao, May 1964, *U. & C. Azegami s.n.* (holo- TNS!).

Presumption: *P. falcatum* A. Gray × *P. involu-cratum* (Franch. & Sav.) Maxim.

*Japanese name.* Takao-waniguchi-so (Ohwi 1965), Waniguchi-naruko-yuri (T. Ohba 1987).

*Chromosome number.*  $2n = 18$  (Tamura 1990a).

*Distribution.* Japan, endemic.

Japan: Honshu (Tokyo, Kanagawa, Yamanashi and Nagano Prefs.). Deciduous forests.

Incompletely known taxa in Japan

*Polygonatum periballanthus* Makino var. *ibukiense* Makino

in Bot. Mag. (Tokyo) 12: 229 (1898). — *P. ibukiense* (Makino) Makino in Bot. Mag. (Tokyo) 21: 139 (1907), p.p. excl. syn.; Makino in Inuma, Somoku Dzusetsu 2 (6): 447, pl. 4 (1910).

*Japanese name.* Ibuki-waniguchi-so.

*Note.* I have not seen authentic material of *Polygonatum periballanthus* var. *ibukiense*. It probably corresponds with *P. × domonense*.

*Polygonatum nipponicum* Makino

in Bot. Mag. (Tokyo) 17: 51 (1903); Makino in Bot. Mag. (Tokyo) 21: 139 (1907), pro syn.; Okuyama in J. Jap. Bot. 12: 355 (1936). — Type: Japan, Honshu, Prov. Iwashiro (Fukushima Pref.), *K. Nemoto s.n.* (n.v.)

*Note.* I have not seen authentic material of *Polygonatum nipponicum*. It probably corresponds with *P. × domonense*.

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